DOCUMENT RESUME

ED 238 718 SE 043 699

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TITLE Teaching Mathematics to Indochinese Students with Limited Proficiency in English.
PUB DATE 30 Oct 82
NOTE 7p.; Paper presented at the Annual Conference of the Association for General and Liberal Studies (22nd, Minneapolis, MN, October 30, 1982).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Asian Americans; *Bilingual Teachers; *College Mathematics; *English (Second Language); Higher Education; *Indochinese; *Language Skills; Limited English Speaking; *Mathematics Instruction; Remedial Mathematics; Second Languages

ABSTRACT

Experiences in teaching a course in developmental mathematics to Indochinese students who were uncertified bilingual teachers employed by the Minneapolis Public Schools are described. The students received training in basic mathematics while being exposed to a college-level course taught in English. Results of a placement test are noted, as well as attempts to teach the course on a number of different levels of mathematical sophistication, while taking into account the language difficulty. (MNS)

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ED238718

Teaching Mathematics to Indochinese Students with Limited Proficiency in English

presented at the

Twenty-second Annual Conference of the
Association for General and Liberal Studies

Minneapolis, Minnesota

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30 October, 1982

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This paper describes my experiences teaching a course in developmental mathematics to Indochinese students. The students were all uncertified bilingual teachers employed by the Minneapolis Public School System and ranged in age from twenty-two to forty. The mathematics course was developed at the request of Dr. Nobuya Tsuchida, Driector of the Asian/Pacific American Learning and Resource Center at the University of Minnesota. The purpose of the course was to provide this group of students with training in basic mathematics while, at the same time, exposing them to a college level course taught in English.

One of the problems in working with non-traditional students is that they do not fit into "regular" academic programs. Usually, a unique program must be designed for them which takes into account their special backgrounds, needs and abilities. When preparing a course of instruction for such students, one must be innovative, flexible, patient, and willing to compromise.

Having taught in the Developmental Mathematics Program of the General College (GC) for the past eight years, I am used to working with mathematically underprepared students. The General College is the open admissions unit of the University of Minnesota and, as such, has a student population with diverse academic, cultural, and socioeconomic backgrounds. Their mathematics needs range from a brief review of the rules of arithmetic and elementary algebra to a need for a complete re-learning, or a first time learning, of the most basic concepts of mathematics. Many are mathematically anxious and most have poor study skills.

The first step in putting together a mathematics course for this special group of students was to determine their mathematics skill levels. To accomplish this, the students were asked to complete the mathematics portion of the General College Placement Testing Program (a copy of the placement test is in the appendix). This test was developed by the General College mathematics faculty for the purpose of placing students into GC mathematics courses (a copy of the course descriptions is in the appendix). The test consists of questions concerning whole numbers, fractions, decimals, percents, elementary and intermediate algebra. The test is administered to all students who enter the General College and is specifically geared to the content of the GC mathematics courses. Based on the results of this test, faculty advisors place students into mathematically homogeneous groups so that the students can be taught as a single class in a traditional lecture setting. This type of class has been found to be most effective with the non-traditional students of the General College.

The results of the placement test given to the Asian students for this class were interesting. The scores on the arithmetic portion of the test ranged from 24% to 96% correct, while the algebra scores ranged from 0% to 100% correct. A number of students scored higher on the algebra portion of the test than they did on the arithmetic portion. This also happens when regular GC students are tested, but not to the extent that occurred with this group of Asian students. It was assumed that this unusual scoring pattern was due to the more highly verbal nature of the arithmetic test questions. For example, it was easier for this group of students to answer algebra questions of the form, "$3X + 2 = 8$," than to answer arithmetic questions such as, "Find the rate of discount if a shirt which regularly sells for $10.95 goes on sale for $8.00." It appears that many of the students did not fully

understand what was being asked in some of the arithmetic questions.

According to the regular placement scheme used by the General College (see the appendix), 32% of the students should have started study in arithmetic, 20% in elementary algebra, 32% in intermediate algebra, and 16% in college algebra or higher.

The obvious way to deal with a class containing this diversity of mathematics skill levels is to set up a course using programmed instruction materials where students are able to work on specific content areas at their own individual rates.

The General College offers such a course on a regular basis, but it was felt that students with poor English skills might have problems reading and learning mathematics from a programmed textbook. In addition, such programmed instruction courses tend to provide little motivation to the students and do not give them enough training in how to take notes, how to succeed in regular lecture courses, how to ask questions, how to take tests, and in the finer points associated with the language of mathematics. Thus, it was decided to teach the course in a lecture format where the teacher and students could interact using English.

The students were informed of their placement test scores and were allowed to decide if they wanted to take the arithmetic part of the course, the algebra part, or both parts simultaneously. All of the students chose to do both parts of the course even though it ment double the amount of work for the same three college credits. Providing instruction at this low level of mathematics was chosen because it was felt that, if students at the upper end of the placement test scale were registered in mathematics courses consistent with their scores, they would have great difficulty due to their language problems.

The students were told that they might be bored with some of the mathematical content of the course, but that they should try to concentrate on the vocabulary used in the course and on how the course was structured. Even though all of the students had had arithmetic in the past, few had gained much experience with the specific procedures used in college classes in this country. The English used to communicate the content presented the students with more obstacles than the mathematical content itself.

On the first night of class, the students were asked to fill out an information sheet (see the appendix). The sheet contained questions concerning the number of hours worked per week, why the students took the class, what type of course they preferred, their gender, age, and intended college major. The information gathered was useful in getting to know the backgrounds of the students and it helped to determine how well the students could read and respond to questions posed in English.

An attempt was made to teach the course on a number of different levels of mathematical sophistication. For example, the rule for dividing two fractions by inverting and multiplying was given so that, as a minimum, students could perform this operation in any given situation. Then, the concept of division as the inverse operation of multiplication was discussed in detail for the benefit of the more advanced students. This allowed the better students to work on a deeper understanding of the topics while

permitting the weaker students to concentrate on the basic procedures needed to solve the problems.

The class, which met one night per week, was structured so that students were given the opportunity to ask questions on arithmetic homework problems at the beginning of each session. After the questions were answered, a lecture on new arithmetic material was given. This was followed by a ten minute break, a question and answer period on algebra and, finally, an algebra lecture.

The lectures, which lasted about one hour each, were designed so that students could ask questions as the new material was presented. The instructor tried to have the students take an active part in the class by continually asking them questions concerning the various mathematical procedures. It was made clear to the students that it was not necessary for each of them to actually answer these questions verbally, but that it was very important for them to at least answer them, in English, "in their own head," so that each student was actively involved in the course during the lectures. This helped the shy students, as well as those whose English was not good enough to give answers verbally. It also forced students to think in English.

The atmosphere of the class was relaxed and friendly. The students were willing and able to help each other with the course material and with the communication problems which arose between the instructor and themselves. On a number of occasions, students had to ask questions in their native language. These had to be translated into English for the instructor by another student.

It is important that students feel comfortable in a mathematics class in order to reduce their anxiety toward college in general and toward mathematics in particular. In this special class, a good deal of humor was used, but it was quickly realized that many of the students did not understand some of the "jokes." It turned out that much background material had to be explained concerning the context of a particular joke before it could be understood by some of the students.

Since the English proficiency of the students was low, it was necessary to write much of what was said on the chalkboard. Many students had difficulty comprehending spoken English but, if given enough time, could read and understand what was being communicated if it was written. Step by step procedures for finding answers to problems were first written on the chalkboard; this was followed by a more detailed explanation of why these algorithms worked. This enabled the students to solve problems using concrete written rules and then, after they became comfortable with the procedures, they were able to take shortcuts and to do more complex problems using their understanding of the concepts. Saying the rules verbally and also writing them helped the students in taking notes and in reinforcing the connection between written and spoken English.

Often, it was difficult for students to make distinctions between the meanings of two sentences which differed only slightly, and to understand how meanings changed when the same words were used in different orders and contexts. For example, the following question was asked: "What is the difference between ten and the sum of two and eight?" One student answered,

"Ten is a single number whereas the sum of two and eight is an addition problem." The student was told that in this instance the word "difference" was used to indicate that a subtraction operation should be performed, not a comparison of terms. She then said that the answer was "nothing." When asked if she ment zero, the student responded, "Yes, nothing." She was then asked, "If the temperature outside were zero degrees, would you say the temperature was nothing?" A discussion of the precision of the vocabulary of mathematics then took place.

A major portion of the class time was spent working with verbal problems. Word probelms are very difficult for all students; for this group of non-native speakers of English, they were particularly frustrating. It is important that students answer the precise question asked in any mathematics problem. Often, trying to figure out just what is being asked is the most difficult part of solving a problem. Distinctions were made between expressions such as, "eight is subtracted from two," "eight subtract two," "the difference of eight and two," and "eight decreased by two." Much practice was provided with this type of problem in both the arithmetic and algebra sections of the course.

Overall, the ten week course was quite successful. Ninty-two percent of the twenty-five students who took the course received passing grades, with 40% receiving a grade of A, 36% B, 16% C, and 8% incomplete. This compares to a 65% completion rate for typical GC arithmetic and elementary algebra students.

The students in this program were more highly motivated and mature than students in the regular GC mathematics courses and in other mathematics courses for special students in which I have worked. Students did not need to be coaxed into doing their homework problems or into coming to class. Some students asked for extra problems so that they could expand their knowledge in different areas of mathematics. Once they have overcome their problems with the English language, the students in the this program should do very well in college.

All students, including those two students who did not finish the course, improved in their ability to answer questions on a post-test of arithemtic and elementary algebra. This is evidenced by the average gain of ten points from pre-test to post-test scores scores on the placement exam. Many of the students learned mathematical concepts and procedures which they had either forgotten or never mastered. However, some of the improvement in student performance on the post-test must be attributed to the increase in the student's English language skills. Students seemed to better understand the questions asked and to be better able to write down their scratch work in an organized manner. It was also evident, from direct observation, that their in-class note taking improved dramatically over the ten week period.

At the end of the course, recommendations were made as to which mathematics courses students should take in the future. Most students were advised to take intermediate algebra as their next mathematics course. They had learned a considerable amount of mathematics content and, perhaps more importantly, they had learned this mathematics in the context of the English language.

It is worthwhile to allow students who have low proficiency in English

to take courses where the content is familiar to them. They need to experience this content in the context of the English language. By doing this, the students are able to concentrate on English in a setting in which they are comfortable with the material, but where the medium of communication causes them difficulty. In such instances, mastering the course content, as well as increasing their proficiency in English, can be accomplished.